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The Optical Properties of the Maritime Aerosol and their Correlation to the Electrical Conductivity of the Marine Atmosphere

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LONG-TERM GOAL

The long term goal is to have a capability of simultaneously measuring aerosol properties, optical properties, and electrical properties from an aircraft in the marine boundary layer. This involves integration of CN counters, particle spectrometers, nephelometers, Gerdien condenser, and radon detector onto the CIRPAS Twin Otter airplane, along with a suitable data acquisition system.

OBJECTIVES

The Scientific or Technical Objectives of this effort are to empirically seek a relationship between the electrical conductivity of the marine atmosphere and its optical properties, such as extinction at various wavelengths. As a result a technique may evolve for estimating optical extinction on bases of a conductivity measurement.

APPROACH

The approach is to synchronously measure extinction at three wavelengths using TSI Nephelometer, and electrical conductivity using Gerdien condenser, and correlate the data. Measurements of particle size and concentration are to be measured simultaneously for calculation of extinction using Mie code for validation of the Nephelometer measurements and to support extrapolation to other wavelengths. Simultaneous measurements of ionization rates by means of the radon detector will be used to constrain the conductivity measurements in coastal areas where continental air containing radioactive agents may be present to varying degrees.

WORK COMPLETED

Aerosol spectrometers, PCASP, FSSP-100, and CAPS, were integrated onto the CIRPAS Twin Otter this summer, along with TSI CN and Ultrafine particle counters. Software was developed to both log and reduce data and calculate optical properties. A three color TSI Nephelometer was also integrated onto the Twin Otter. Software was developed to log its measurements, but data reduction routines are still to be developed. The Gerdien condenser is under development and a Radon detection system has been ordered. The Aerosol instruments and the Nephelometer were flown this summer during the DECS experiment yielding much data that are presently being analyzed and processed.

RESULTS

It is too early to draw any conclusions from the work thus far. As preliminary results from the DECS mission, however, it is clear that both the aerosol measurements and the nephelometer measurements are well enough along to warrant integration of the electrical component. Size distributions based on frequent calibration appear fairly consistent between the spectrometers, and cover the optically active size range (Dp> 0.1 □m). Preliminary viewing of the Nephelometer data similarly indicates that a good data set was obtained. Data reduction, however, is in progress, and analyses have not started yet.

IMPACT/APPLICATIONS

Depending on the results of this research, an alternative technique may result for evaluating optical properties of the marine boundary layer. If a tight correlation may be established between conductivity and extinction, then the simple, and robust measurement of conductivity may yield quantitative information on extinction.

TRANSITIONS

As the results still are preliminary, and the electrical component of the payload still has not been implemented, at this point the primary results sought are not available. However, collaborators during the DECS experiment are using the particle and optical measurements for validation of satellite sensors, for validation of radar observations, for study of aerosol source strength in the marine boundary layer, for study of roles of aerosol particles in cloud dynamics, and for study of formation and perpetuation of rifts in stratus decks.

RELATED PROJECTS

The measurements obtained in this project are also valuable in projects such as those outlined in the last item. Also, however, the results will enhance the value of a century long record of conductivity measurements that exists.